Dr. Leconte was only twenty when he published his first descriptions. The material is on hand in this building waiting for you to go to work and follow in his footsteps.

Gentlemen, I thank you for your attention, and congratulating you upon the healthy growth of the society and urging upon you the need of more copious field notes, of more paragraphs for the JOURNAL and of more specialists in the society, I wish you all good health, good luck and lots of good bugs for 1911.

NOTES ON COCCINELLIDÆ. IV.

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VARIABLE MACULATION IN COCCINELLIDÆ.

The variable character of the maculation of the Coccinellidæ is not only shown by inspection of the insects themselves but is reflected in the numerous specific names indicating spots, stripes and bands that have been applied to them. In no other family do we find so many names like *unipunctata, bipunctata, tripunctata,* etc., which are repeated in the Coccinellidæ over and over again and might be arranged in a complete series to *28-punctata,* with no numbers missing except perhaps 17 and 23. Even combinations like *bistripustulata* have been formed to indicate the number of spots; and *fasciatas* and *cinctas* and *lineatas* in all manner of combinations to describe other styles of ornamentation.

The question arises in the study of these insects as to how much importance is to be attached to these differences in maculation. Does each pattern indicate a genus or a species, and each variation in the pattern a subspecies or variety requiring a name; or are the differences sometimes merely individual characteristics? Are some of the species capable of producing offspring decidedly different in maculation? Are such differences in maculation partly due to temperature and moisture or some other pupal environment?

In connection with these questions we may compare the method of treating similar differences in the European Coccinellidæ and two papers that have recently appeared in America, viz., "Notes on the

Coccinellidæ," by Thos. L. Casey (Can. Ent., XL, 1908) and "Determinate Evolution in the Color Pattern of the Lady Beetles," by R. H. Johnson (Carnegie Inst., June 29, 1910). The former European practice is shown in the "Bestimmungs-Tabellen der Europäischen Coleoptera, II, Coccinellidæ," 1879, by Julius Weise, in which every difference in maculation known to its author seems to have received at least a varietal name. Under some species many varieties are cited, and since 1879 their number has been increased. The tables show no characters for their separation except maculation. This practice does not seem to meet with general approval and various articles showing the common parentage of the supposed varieties have been printed. Weise himself in a letter deprecates too great reliance on color characters and Casey says, "A large proportion of them are really synonyms."

Casey's paper is important on account of his voluntarily reducing a number of his previously described species to the rank of subspecies, in harmony with his criticism of the European method. Otherwise its attitude appears to be not very different from that of his former work on Coccinellidæ published in 1899, in which he did not hesitate to adopt "type of coloration as a primary taxonomic character" (Jour. N. Y. Ent. Soc., VII, p. 121).*

To the student of Orthoptera or Lepidoptera this may appear a safe course to pursue; but to one accustomed to the variable maculation of the Coccinellidæ it cannot be acceptable without an examination of the foundation on which the theory was built and the results which followed its use. The collection with which he worked would be the natural foundation and, by several statements, seems to have been too small to justify the generalization. *E. g.,* in speaking of *Hippodamia glacialis* he says (p. 79), "anterior spot always wanting," whereas in fact no very large series is needed to show that the spot is frequently present. Again (p. 106), speaking of *Axion*

* This theory in his own words is "Type of ornamentation has not been regarded as a generic character hitherto, but is in reality one of the most important, especially that of the pronotum" (JOUR. N. Y. ENT. SOC., VII, p. 82). Later in the same article the idea is presented a little more strongly, viz., "Ornamentation may become in other words as important a generic structural character as any other special modification" (p. 120), and on page 121, referring to *Hyperaspis:* "In adopting type of coloration as a primary taxonomic character, however, this is restricted below to the patterns of the elytra" (p. 121).

3-pustulatum, he says, "does not seem to be at all abundant, and my cabinet contains only the single specimen taken some twenty years ago." Mr. Davis has taught us that this species is abundant on oaks infested with Kermes. Instances might be multiplied by citing the species he has described from single specimens, but the above are sufficient to show the weakness of the collection with which he worked. As to the results he reached by using type of coloration as a primary taxonomic character, we may compare his statement (p. 109), "*ovoideus* and *desertorum* of the table are in all probability subspecies of *californicus*," with this sentence printed nine years later: "Neither of these forms (*ovoideus* and *desertorum*) has anything whatever to do with *californicus*, either in general appearance or other token of consanguinity." The first statement was possibly the result of studies based on type of coloration alone; the second followed the description in our JOURNAL of the structure of the claws.

Again, in the Canadian Entomologist article, p. 413, Casey has described *Brachyacantha metator* n. sp., using color and maculation as his guide. Later in Volume XLII, p. 109, he has transferred this species to *Hyperaspis*, because an examination of the structure of the tibiæ showed the absence of the tooth which is characteristic of the genus in which he originally placed it.

There is no intention in these remarks to belittle Major Casey's work, which indeed speaks for itself; but the intent is to show that his adoption of type of coloration as a primary taxonomic character was based upon the study of too few specimens to enable him to judge correctly the status of each specimen and led him into a number of confessed errors which, to a certain extent, must deprive his conclusions of the authority they would otherwise derive from his long experience in the study of Coleoptera.

Let us now compare the information contained in Johnson's work. This author was fortunate in finding a hibernating mass of 15,415 individuals of *Hippodamia convergens* at Marsh Hill, Fairfield, Wash., which being sorted was found to contain 6,954 normal specimens and 63 different varieties, some so close to normal *convergens* that they would have been accepted as such, others more aberrant and gradually leading to the varieties that had already been suppressed as synonyms and beyond them to varieties that had previously, in the light of the series ordinarily found in good collections,

seemed distinct. Johnson's figures on page 28 would seem sufficient finally to prove the relationship of these supposed varieties of *convergens,* for scarcely a conceivable intergrade is missing. In connection with the large number of specimens he found, it is worth while to mention that F. W. Nunemacher found a cliff 300 feet long at Cactus Springs, Nevada, covered with *Hippodamia convergens.* He says the whole country was red with the congregated insects (Ent. News, November, 1910). The study of these captures, perhaps, was the foundation for the statement of Carl Fuchs at a meeting of the Pacific Coast Entomological Society that the number of spots he had observed in *Hippodamia convergens* ranged from none to twenty-two, with other variations (Ent. News, November, 1910, p. 432).

To return to Mr. Johnson's discoveries, he found also a mass of *Hippodamia spuria* in which, out of 759 individuals, only 256 were normal. On page 47 he figures the abnormal specimens which, as in the case of *convergens,* include patterns previously regarded as distinct and the intergrades leading to them. The ideas which these finds engendered were corroborated by a series of *Coccinella subversa* in my collection obtained by Miss Florence Dennis at Dilley, Oregon, of which many specimens are illustrated on page 59, and by many similar though smaller series in the various collections Mr. Johnson examined, and led him to attempt by artificial breeding to show that the variation he had observed was determinate, *i. e.,* a progressive variation in some definite direction. While his experiments in this direction do not seem to have been sufficiently continued to prove the case as completely as the corresponding experiments of Tower with *Leptinotarsus,* they throw a great light on the variable maculation of Coccinellidæ. He found, for example, that "an increase of pigment was obtained by exposing the prepupa and pupa to the cold of a refrigerator (5° to 15° C.), a cellar (15° to 17° C.) and the intermittent temperature of a room where the temperature dropped during the winter months to 5° C. at night." At the same time he observes that "subspecies of the mountains and high latitudes" show "a larger percentage of the absence of pronotal dash," and by inference from other passages he might have added that such subspecies (as he calls them) always have more black markings. He found that breeding from an abnormal female of *Coccinella 9-notata* resulted in a progeny in which the peculiarities

of the mother were not only reproduced in part of the offspring, but greatly exaggerated in some. His figures on page 61 of these descendants of *C. 9-notata* seem to be sufficient to account for any extraordinary unique occurring in nature.

Other observations which are instructive are those on the inconstancy of the sculpture and shape of the elytra which have been relied upon by some authors to support differences in maculation. Many other interesting sentences might be quoted, but perhaps the strongest one of all for our present purpose is the brief summary on page 81 of all Johnson's observations and experiments—"*diversity prevails.*"

Thus we have seen that while the European practice has been to apply names freely to the variably maculate Coccinellidæ, and to some extent the same practice has been followed by Casey on the ground that type of coloration may be adopted as a primary taxonomic character, yet an examination of very large series in three species discloses an extraordinary amount of individual variation and Johnson's experiments in breeding show even greater possibilities in the same direction and justify a conclusion that such variations in maculation are more often individual than racial.

With the proviso that the conclusion is restricted to Coccinellidæ and does not by any means include such beetles as Cicindelidæ, which are more subject to the influence of isolation, it may be regarded as proved by Johnson's observations and experiments, as well as by other evidence, that there is a strong tendency to a variability in maculation in Coccinellidæ which is purely individual, as shown in the various series quoted; that the effect of the cold of high latitudes and elevation is always to produce more black coloring; and that therefore specific names based on maculation alone cannot properly be applied to such variations in Coccinellidæ and such as have already been applied can at best be regarded at varietal names.